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IMPERIAL BUREAU OF MYCOLOGY

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CHEVALIER (A.). **Sur une Maladie des Agaves.** [Note on a Disease of Agaves.]—*Rev. de Bot. Appliquée*, i, 1, pp. 21-23, 1921.

Sisal plants in Indo-China and the French Sudan have been attacked by a fungus which Patouillard has identified as *Colletotrichum Agaves* Cav. Elliptical brown patches, more or less confluent, appear in the lower leaves, which are rendered useless by the decay of the tissue. Similar symptoms have been observed in a park near Marseilles on *Agave americana* L., *A. Salmiana* Otto, and the varieties. *A. applanata* Lem. ex Jacobi appears to be immune. The author regards the disease as identical with the anthracnose of Sisal reported from India in 1913 by Shaw.

Verslag over het Jaar 1920. Dept. van den Landbouw in Surinam. [Report of the Dept. of Agric., Surinam, for the year 1920.] Pp. 16-20, 48, & 63-64. Issued 1921.

A great many Liberian coffee-trees were attacked by the sieve-tube disease (phloëm-necrosis), while two specimens of *Coffea arabica* were also affected by it for the first time. *Sclerotium* disease also occurred sporadically, but did not cause much damage. The importance of this disease is apt to be under-estimated, since it can easily become epidemic under favourable weather conditions. Bordeaux mixture should be applied as a preventive.

During the period covered by the report, a bacillus was isolated from some coco-nut palms attacked by bud-rot disease. Externally the bacillus corresponded with that isolated by Johnson from coco-nut palms. With this organism, cultivated on agar and shaken up in water, the young leaves of thirty-six coco-nuts and twelve oil-palms (*Elaeis guineensis*) were inoculated by pouring the suspension between the youngest leaves. After some months all the oil-palms were dead, but not a single coco-nut. This merely proves, however, in the author's opinion, that the bacillus cannot infect coco-nut palms in the particular manner described, not that it is incapable of pathogenic action under other conditions.

At the end of 1920 only thirteen oil-palms remained out of 130 African trees mentioned in the 1919 report as being attacked by bud-rot. The prevalence of this disease among palms imported from Africa is such that their cultivation in Surinam cannot be recommended. The course of the disease is so rapid that combative measures are of no avail. The native varieties of oil-palm produce annually a much greater number of clusters, but the weight of these is less than in the African palms.

Investigations in the Philippines have shown that bud-rot of coco-nut palms can be produced by the fungus *Phytophthora Faberi*, which also causes cacao canker and black rot of cacao fruit. A number of coco-nut palms—some young and others eight years old—were infected with spores of *P. Faberi*, the method employed being the same as in the bacterial inoculations, and very quickly exhibited large watery spots, 1-2 cm. in diameter, on the youngest parts of the leaves. Microscopical examination revealed the typical *P. Faberi* mycelium, and after a day in a moist atmosphere the first conidiophores were visible. These experiments were not carried out until the end of the year, so that definite information as to the presence of bud-rot cannot be included in this report, but it is certain, at any rate, that *P. Faberi* is capable of penetrating the young tissue of the Surinam coco-nut palms, and it is possibly responsible in part for the bud-rot disease.

Erythrina glauca has been severely attacked by a fungus, not yet identified, which causes a bark disease. The tissues are penetrated by numerous white rhizomorphs, which finally pierce the wood and continue to develop in the medullary rays and parenchyma. Exposed to the air, the rhizomorphs turn sea-green. As soon as the decay reaches the base of the trunk the trees fall.

There have been cases of a disease of Bourbon sugar-canes closely resembling, and probably identical with, the Yellow Stripe or Mosaic disease, which is so widespread in Porto Rico. The leaves were typically striped, and there were canker-like spots on the internodes. The disease is commonly transmitted by insects, though it may also be propagated by setts.

Frequent inquiries are made by planters as to the desirability of planting *Lagarto cacao* (*Theobroma pentagona*) on account of its resistance to curl-disease (*Marasmius perniciosus*). Experiments have shown that this variety is not absolutely immune, though its powers of resistance are very considerable. Planted in an infected environment, however, a small proportion of the plants succumb. Like *Theobroma bicolor*, *Lagarto* is less susceptible to the disease than the ordinary variety (*Theobroma cacao*).

SMALL (W.). **Annual Report of the Government Botanist for 1919-1920.**—*Annual Report of the Dept. of Agric.* (Uganda Protect.), pp. 42-44, 1921.

Fungous diseases of the following plants are referred to:—

COFFEE. Many reports of die-back were received, and species of *Colletotrichum*, *Phoma*, and *Fusarium* associated with the disease were isolated and used for inoculation. The results are being separately published. [See next abstract.]

It has been shown that the Variegated Bug carries the pycno-

spores of the same *Phoma* as is found on the coffee branches. This fungus also occurs on the broken cotyledons in the condition known as 'broken beans', thus leading to the conclusion that the insect is implicated in the damaging of the beans.

HEVEA. The present immunity of Hevea rubber from Brown Root Disease (*Hymenochaete noxia* Berk.), Wet Root Rot (? *Sphaerostilbe repens* B. and Br.; *Poria* sp.), and *Ustilina zonata* (Lév.) Sacc., is ascribed to its being grown on elephant-grass land instead of forest-land, where decaying stumps constitute favourable breeding grounds for the diseases in question. Growers are warned not to leave Hevea roots in the ground after the thinning of the trees.

Bark and cortex diseases have been prevalent, but microscopic examination of the diseased tissues, particularly of what is known as Brown Bast, has failed to disclose the presence of any mycelium or other part of a fungus. Further investigation is in progress.

CACAO. It has been shown that the cacao *Colletotrichum* is capable of infecting coffee. Rotting cacao-pods with pink spore masses of *Colletotrichum* should be burnt as they are a danger to coffee.

NATIVE CROPS. Areolate mildew (*Ramularia areolata* Atk.) and boll-anthraxnose (*Colletotrichum gossypii* Southw.) of cotton have been reported from various districts. Rust (*Puccinia graminis* Pers.) and loose smut of wheat (*Ustilago tritici* Jens.) were also found.

ORNAMENTAL AND SHADE PLANTS. Wilts of carnations, larkspurs, and love-in-a-mist, all from the same garden, were due to a single species of soil *Fusarium*.

Wet Root Rot, previously known on Hevea, ceara, tea, coffee, cacao, and guava, has now also affected *Casuarina equisetifolia*, *Hibiscus*, *Eucalyptus*, and mango.

Albizia moluccana, planted as coffee shade, has succumbed to root disease in two instances. In one, *Fomes lucidus* Fr. was found on the collar of a tree which had been dead for some time, and in the other, *Rosellinia*-like fructifications on the under sides of the main roots, near the trunk of the tree. Neither fungus has attacked the interplanted coffee.

Grevillea robusta is subject to a die-back, which is accompanied by gummosis. The leading shoot or any branch on any part of the tree may be affected. An Ascomycete, obtained from diseased trees, has been identified as *Nectria flocculenta* v. Hoen., and is most probably the cause of the disease.

SMALL (W.). Notes on Species of *Colletotrichum* and *Phoma* in Uganda.—*Kew Bull. Misc. Inform.* 2, pp. 57–67, 1921.

A species of *Colletotrichum* causing leaf-blotching and gradual withering of branches of *Coffea arabica* was first recorded in Uganda about 1908. Massee had proposed the name of *Colletotrichum coffeae* for this fungus, but his description has never been published, and there is every likelihood that it was identical with the widely-distributed *Colletotrichum coffeanum* Noack, described in 1901 from Brazil, as the latter has been found to occur regularly on Uganda coffee in association with the disease known as 'die-back'.

Gloeosporium coffeanum Del., in the writer's opinion, is probably the same fungus. Another species of the same genus, *G. incarnatum* Zimm., which probably is identical with *G. coffeanum*, has been known for several years in the former German East African colony, and has also been given as the cause of a die-back of *Coffea robusta* in Ceylon.

Of late years there has been a tendency to ascribe all coffee die-back to the work of *Colletotrichum*, but it was pointed out in 1915 that other fungi were found commonly on die-back branches, and it was also emphasized that various physiological factors were involved in the causation of the disease. Among other forms found at times on die-back coffee branches in Uganda are *Periconia byssoides* Pers., *Fusarium coffeicola* Henn., *Fusarium* sp., and *Tubercularia* sp., all of which are regarded as saprophytic, together with a *Phoma* which has a *Coniothecium*, and possibly an ascigerous stage on the branches, a *Glomerella*, which is the perfect stage of the *Colletotrichum*, and the perithecia of the sooty mould fungus, *Capnodium brasiliensis* Putt. Cultures were obtained of *Colletotrichum coffeanum*, *Phoma*, *Fusarium coffeicola*, and *Fusarium* sp., these fungi being more consistent in their presence on die-back branches, and seeming to be more implicated in the production of the disease, than any other forms.

The characters of *Colletotrichum coffeanum* in culture are described. The formation of setae takes place comparatively seldom; in the acervuli of *Colletotrichum* on twigs in a damp chamber setae frequently do not develop at all, or they may appear late, when conidial production is slackening down; on sterilized coffee leaves no setae are produced by the fungus, and this is also the case in nature when the fungus attacks the leaves. On the berries, again, setae may or may not occur. The presence or absence of setae is thus an inconstant character, and, though it has been usual to refer setaeless acervuli to the genus *Gloeosporium*, the writer's opinion is that the acervuli and conidia of *Gloeosporium* on the leaves (*G. coffeanum* Del.) and the *Colletotrichum* on the stems are indistinguishable, and that the two species may well be the same. It is generally agreed that the separating line between *Colletotrichum* and *Gloeosporium* is a narrow one, and that the basis of distinction is artificial, and it would appear that the presence or absence of setae is governed more by physiological conditions than by a hard and fast morphological rule.

Inoculations were made with pure cultures either by wounds and punctures on twigs at the nodes, in the course of the internodes, and at the tender growing-point of the stem, or by placing the inoculum on both surfaces of leaves, on the unwounded bark of nodes and internodes of twigs, and upon the apical growing-point. Leaf inoculations were far more successful than any of the others, in some cases giving 100 per cent. positive results. Older, tougher leaves were as susceptible as younger ones, and the upper surfaces as the under. The first signs of leaf-infection were noticeable after fifteen or sixteen days, and the mycelium of the fungus was traceable through the leaf-petioles into the stems. Later, numerous acervuli developed on the twigs bearing the inoculated leaves and on the leaves themselves after about ten days in a damp chamber.

The only successful stem inoculation was made through a punctured wound in the growing-point. Twelve days after inoculation the stem apex began to blacken; this was followed by the collapse of the apical pair of leaves and by the extension downwards of the discoloration. *Colletotrichum* was afterwards recovered from the affected stem.

The fungus is not an aggressive parasite of coffee, requiring favourable conditions or weakness of the bushes to bring on an attack. Over-bearing, neglect of cultivation, and the attack of *Hemileia* are predisposing causes.

After the lapse of from fifteen to twenty days, certain of the pure cultures of *Colletotrichum coffeanum* show caespitose perithecia of a species of *Glomerella*. These succeed the acervulus stage; in nature they may be found on die-back twigs after the lapse of a few months. This *Glomerella* has been identified at Kew as *G. cingulata* S. & v. S.

The author compared *C. coffeanum* with *C. incarnatum* Zimm. and *C. theobromicolum* Del., which occurred on rotted and hardened cacao pods, and concluded that the morphological differences between them seem too slight to justify their separation into distinct species. Furthermore, cross-inoculations proved that *C. coffeanum* is capable of vigorous growth on cacao pods and twigs; its effects were indistinguishable from the usual cacao-pod rot of Uganda, and the *Colletotrichum* and *Glomerella* on the pods and twigs were morphologically indistinguishable, the former from *C. coffeanum* or *C. incarnatum*, the latter from the *Glomerella* on coffee twigs. Cultures from *Colletotrichum* conidia from rotted cacao pods still on the trees were used to inoculate coffee leaves, and all gave positive results; an asctose *Colletotrichum*, indistinguishable in other respects from *C. coffeanum*, was recovered in all cases.

Colletotrichum camelliae Mass., the fungus causing Brown Blight of tea, is found in Uganda on tea leaves of all ages; the *Glomerella* stage has not yet been met with in nature, and the fungus has not been studied in pure culture, nor have cross-inoculations been carried to a successful conclusion. The writer, therefore, does not find it possible to assert that the tea *Colletotrichum* stands in the same relationship to *C. incarnatum* or *C. coffeanum* as the latter two stand to each other, but he points out that, morphologically, *C. camelliae* is as similar to *C. coffeanum* as this latter to *C. incarnatum*. It is mentioned that Tunstall has shown that the *Colletotrichum* which causes Brown Blight of tea in Assam is the conidial stage of *Glomerella cingulata*.

Species of *Colletotrichum* have been found on garden plants of *Codiaeum* and *Eranthemum* which were dying back. They are morphologically similar to each other and to *C. coffeanum*, but as yet their relationships have not been experimentally tested.

A certain amount of the cotton crop in Uganda is yearly lost in consequence of anthracnose of cotton-bolls, caused by *Colletotrichum gossypii* South. Its perfect stage, *Glomerella gossypii* Edg., is to be found only at times, for the conidial condition is much more common than the perithecial.

Gloeosporium musarum Cke. & Mass. sometimes occurs on ripe bananas in Uganda, causing black spots which eventually lead to

a complete rot. *Gloeosporium albo-rubrum* Petch occurs on green shoots of *Hevea*, and causes them to die back. In this way it is responsible for the entry into the tree of *Botryodiplodia theobromae* Pat. *C. albo-rubrum* is frequently found in close association with *Phyllosticta ramicola* Petch. Other species of *Colletotrichum* (*Gloeosporium*) occur on mangoes, guavas, pomegranates, and species of *Citrus*, but they have not yet been investigated.

The *Phoma* from coffee twigs suffering from die-back was obtained in pure culture, and its cultural characters are fully described. It has a *Coniothecium* stage which has also been found on the twigs, but never, so far, in the tissues. No further stage in its development has been observed.

Out of a series of sixty inoculations on coffee trees with material from *Phoma* cultures, only one was successful; in it pycnosporous had been placed on the unbroken internodal bark of a branch, the apical branches of which began to droop after two months. Mycelium was found in the branch tissues near the point of inoculation, and *Phoma* was subsequently recovered. Still, the author thinks that infection in another way may be more frequent. One of the most dangerous coffee diseases is caused by the Variegated Bug (*Antestia orbitalis*, Westw., var. *faceta*, Germ.), which punctures and sucks the juices from the twigs, buds, and berries. In order to test the theory advanced in 1916 that this pest is actively implicated in the transmission of fungous infection, the author prepared cultures from its legs and beak. In all the cultures, except one which was productive of bacteria and moulds only, *Phoma* mycelium appeared aurally in forty-eight hours. If, as appears probable from these experiments, the bug commonly carries spores of *Phoma* in or on its beak, with which it pierces the tender tissues of the plant, it is not unlikely that it is responsible for the presence of the fungus in tissues which the latter might be otherwise incapable of penetrating. There is also no reason why other scale insects, aphids and borers known on Uganda coffee, none of which has yet been examined on these lines, should not carry and introduce into the tissues both *Colletotrichum* and *Phoma*.

The inoculation results show that *Phoma* by itself is not an aggressive parasite, and there is no Uganda evidence of such a *Phoma* disease of coffee as that described by Dowson in British East Africa. The recommendations made with regard to the coffee die-back with which *Colletotrichum* and *Phoma* are implicated consist of measures designed to produce a healthy and resistant tree.

The only other species of *Phoma* found on a plant of economic importance is *Phoma Heveae* Petch, which occurs on *Hevea* branches, apparently without causing any harm.

NOBÉCOURT (P.). **Action de quelques alcaloïdes sur le *Botrytis cinerea* Pers.** [Action of certain alkaloids on *Botrytis cinerea* Pers.]—*Comptes Rendus de l'Acad. des Sciences*, clxxii, pp. 706–708, 1921.

As part of a research on the causes of immunity in plants, the writer tested the action of several alkaloids on *Botrytis cinerea*, which is known to attack certain plants (cinchona, tobacco, *Atropa*

Belladonna) rich in these substances. The result showed that nicotine and atropine had no effect on the fungus at concentrations probably higher than is ever found in the plant. Quinine is unfavourable at fairly high doses, and aconitine at feeble doses. The fungus which causes the 'Maladie de la Toile', shown by Beauverie (*Etudes sur le polymorphisme des Champignons*) to be a sterile race of *Botrytis cinerea*, was found to be less resistant to alkaloids, and the strengths which inhibit growth are such as to suggest that aconite should be quite immune, and tobacco very resistant, to this disease, while atropine had less effect.

GLEISBERG (W.). *Botrytis-Erkrankungen*. [The causation of disease by *Botrytis*.]—*Gartenflora*, lxx, 1-2, pp. 13-19, 1921.

The occurrence of sharply-defined brown spots on primula leaves, sometimes isolated and sometimes confluent, led to the investigation of a curious phenomenon connected with the biology of *Botrytis cinerea*.

Careful examination of the primulas in question (*P. Kaschmiriana*, *P. Veitchii*, and *P. veris*) showed that some of the spots were covered with the decayed blossoms of a *Robinia pseudacacia* standing near by. These blossoms, which adhered closely to the leaves on which they fell, were also found on ivy, *Picea pungens*, and *Abies concolor*. In the two latter cases, however, there was no discoloration. Conidiophores of *Botrytis cinerea*, emerging in fascicles from the stomata, were visible on the under side of the spots.

The fact that similar spots occurred on elm and dandelion leaves, as a result of falling elm seeds, disposes of the theory that *Robinia* alone is responsible. Experiments also proved that the formation of the spots was not due to any chemical peculiarities of the flower-extract. The fungus must therefore be regarded as a facultative parasite, which requires a decaying substratum and a certain degree of humidity, or an acid plant-extract, to assist it in the attack of living plants. The decay of the blossoms and the action of the mycelium in the leaf, the agglutination of the cell-content and its discoloration, stamp the fungus as an agent of humification in an advanced degree.

PAPE (H.). *Beobachtungen bei Erkrankungen durch Botrytis*. [Observations on the causation of disease by *Botrytis*.]—*Gartenflora*, lxx, 3-4, pp. 48-50, 4 figs., 1921.

The foregoing observations of Gleisberg on *Botrytis* have led the writer to describe a similar experience which occurred in 1920. After a rainy period at the beginning of September, the leaves of both *Nicotiana rustica* L. and *Nicotiana tabacum* L. exhibited dry, brown spots, which appeared as the result of contact with the withered petal tubes of the flower. These spots were either isolated and sharply defined, or merged into one another when several petals fell on the same leaf. As a rule, the petals were abundantly covered with the mycelium of *Botrytis cinerea*, and in some cases this was transmitted to the spots themselves, and appeared on the surface of the leaf. In cases where the fructifications were not visible at first, they appeared after one or two days in a humid atmosphere. The tissues of the spots, even of those on which the

fungus was not apparent, were also found on microscopic examination to be completely penetrated by the mycelium.

The following are further examples of the capacity of *Botrytis* for proceeding from decaying vegetable tissues to the live parts of the organism:—

(1) A number of bean seedlings (*Phaseolus vulgaris* L.) in a greenhouse showed signs of withering. On examination they were found to be infected with *Botrytis cinerea*, which had first attacked the dying cotyledons, and thence spread to the young living tissues above them. The plants did not recover.

(2) In the late summer some fully-grown Soya bean plants began to wither. In this case, too, *Botrytis* had evidently first attacked the withering young pods on the upper part of the plant, and then proceeded to the main axis. In some cases it was noticed that the fungus was transmitted by direct contact from the tip of the pod to the stalk, without first passing through the entire pod.

THOMAS (H. E.). **The Relation of the Health of the Host and other Factors to Infection of *Apium graveolens* by *Septoria Apii*.**—*Bull. Torrey Bot. Club*, xlviii, pp. 1-29, 1921.

After a brief account of the late blight of celery and a description of the characters of the parasite, accompanied by bibliographical references, the problem of the relation of health, age, and other conditions to susceptibility, as determined by the results of the extensive inoculation experiments, is considered. The parasite was found to be very limited in its host range, perhaps entirely restricted to *Apium graveolens* and its variety *rapaceum*. Parsley (*Petroselinum sativum*), contrary to what might be expected from earlier statements, is not infected by the form here studied. On celery there is some difference in the susceptibility of different varieties, but none tested had any pronounced resistance. Golden Self-Blanching was especially susceptible both in the greenhouse and in the field.

The tests on plants variously treated with fertilizers and in other ways so as to modify the vigour and rate of growth of the plant are of the highest interest, and the conclusion is drawn that in a general way anything that favours the growth of the host increases susceptibility. This was specially marked when pot-bound plants were treated with nitrate of soda, which increased growth, but more than doubled the amount of infection as measured by the number of spots per leaf in atomizer inoculations. Calcium sulphate and hydrated lime slightly reduced susceptibility, the latter visibly reducing the vigour of the plant. In comparing lime with nitrate of soda in another series the latter averaged 284 spots per leaf as against 120 for the former, and what is perhaps even more significant, the difference in size of the spots was proportional, the spots of the nitrate plants averaging 2.64 mm. in diameter, while those of the lime plants averaged only 1.06. The ratios are 1:2.36 and 1:2.54 respectively. These data indicate that the degree of susceptibility is dependent upon the interchanges between the host cells and the fungus hyphae rather than upon the ability or lack of ability of the fungus to penetrate the host. Besides nitrate of soda, complete nutrient solution and top-dressing with sheep manure

increase the susceptibility. Plants infected with nematodes (*Heterodera radicicola*) have their susceptibility much reduced when the infestation is really severe, which is usually only the case in badly pot-bound plants. Where vigorously growing plants have nematode galls there is no reduction in susceptibility. In one case a very heavily infected plant was found to be highly resistant to the disease, and even when transferred to a larger pot with fresh soil, so that it was able to make considerable growth, it remained practically immune. After treatment with a nutrient solution, however, a large number of small spots developed. Etiolated plants, produced by keeping in a dark room for nine days before inoculation, had less than half as many spots on each leaf as the controls. The reduction in leaf area was plainly not commensurate with this difference. When plants were placed in the dark for three and a half days after inoculation no difference in degree of infection was noticed nor any delay in the first appearance of the spots. The average size of the spots was also less in plants etiolated before inoculation.

The young leaf is susceptible as soon as it comes into view. Leaves that are still growing have a much larger number of spots from inoculation than those that are mature. But the older the leaf the more rapidly the intervening tissue between the spots breaks down, and also the larger the individual spot, except in etiolated plants, where the spots on the young leaves developed in the dark are as large as those on the very old leaves. The older leaves were found to be markedly more acid than the younger in normally grown plants. Etiolation is, however, known to increase acidity, and there is therefore a suggestion that there is a relation between resistance and acidity, though this would appear to be other than the simple direct relationship claimed by Comes in his well-known researches on the subject.

The above results are considered to show that *Septoria Ayni*, though it readily assumes the saprophytic habit, has become so adapted to its host that the development of infection is favoured by increased growth of the host such as is produced by feeding with nitrates, with a complete nutrient solution, or by top-dressing with sheep manure, while top-dressing with lime decreases the infection, and so does severe infestation by nematodes. The work of other investigators in this field is referred to, and attention called to the tendency shown by highly specialized parasites to become in some sense symbiotic rather than antagonistic for at least a part of their life in the host. In relation to age there appear to be two sets of conditions operating, one which governs the establishment of infection and another which determines the rate of subsequent spread of the mycelium. The number of spots on old leaves produced by inoculation is less, but their first appearance to the eye is earlier and their rate of growth greater than on younger leaves.

ADAMS (J. F.). **Observations on Wheat Scab in Pennsylvania and its Pathological Histology.**—*Phytopath.*, xi, pp. 115-124, pl. 2 & 3, 1921.

In 1917 the average infection of wheat heads with scab in

Pennsylvania was estimated at two per cent., the highest in observed fields being eight per cent. It is greatest when wheat follows maize. On the old maize stubble perithecia of *Gibberella saubinetii* are commonly found in spring, and these are no doubt partly responsible for infecting the wheat. On wheat these perithecia were not found, but cultural study of the organisms on the scabbed heads indicated that this fungus is the usual cause. This agrees with the work of Johnson, Dickson, and Johann (*Phytopath.*, x, p. 51, 1920), where less than one per cent. of the isolations gave other fungi (*Fusarium culmorum*, *F. avenaceum*, &c.) capable of causing scab.

The conditions found in infected kernels are fully described and figured from microtome sections. All parts are invaded, entry being apparently usually through the germinal end and the fungus having a special affinity for the embryo. The endosperm is also usually destroyed more or less completely. The glumes and rachis are more resistant. Infection appears to occur after the flowering stage as a rule.

Wheat seedlings were readily attacked by cultures isolated from scabbed wheat as well as from corn root rot. But it is probable that soil and temperature conditions with the autumn planting of wheat are not conducive to seedling infection under field conditions.

MARTIN (F. J.) & MASSEY (R. E.). **Experiments on Wheat Growing in the Sudan.**—*Wellcome Tropical Research Laboratories, Chemical Section*, Publication No. 19, Khartoum, 1921.

The indigenous Sudan wheat, chiefly grown in Dongola and Berber, is unsuitable on account of its comparatively long period of development, susceptibility to rust, and admixture of strains and varieties. Rust reduces the yield materially, and is favoured by late development, as black rust generally makes its appearance only towards the end of the season. Pure strains were isolated from the local wheats, and tested with imported varieties from Australia, India, Egypt, and elsewhere. Only those from the three mentioned sources appear promising. The only kinds that have yielded good results are the early varieties. None of the Australian kinds tested have rusted, though native wheats near by were attacked; most of the Indian wheats also escaped rust, while all the Egyptian were attacked. The best yielders were Federation, Firtank (both Australian), and Indian No. 40 (a selection from commercial Indian wheats). All these escaped rust, and gave a better quality grain than the indigenous. They have a short growing period and good milling qualities. All the Australian varieties were upstanding and strong, the most robust being Federation. The Indian wheats were slender, and in some cases weak in the straw (Indian No. 7 and Pusa 3 x).

THATCHER (L. E.). **A Fungus Disease suppressing Expression of Awns in a Wheat-Spelt Hybrid.**—*Journ. Agric. Res.*, xxi, 10, pp. 699-700, 1921.

Experiments carried out at the Ohio Agricultural Experiment Station with a number of F₂ hybrids between *Triticum vulgare* Vill. and *Triticum spelta* L. demonstrate the possibility of isolating segregates resistant to *Tilletia foetans* (B. and C.) Trel., with the

spores of which the seeds of the experimental plants had been treated. The result showed that, out of 124 F₂ plants, (1) nineteen had all spikes diseased, (2) seventy-two had not all spikes diseased, (3) thirty-three had all spikes disease-free.

The interesting discovery was made that those plants which were awned segregates of Class 2 showed normal development of the awns in the disease-free spikes, and a suppression of awns in the diseased spikes. No spikes were found containing both diseased and disease-free kernels.

JENKIN (T. J.) & SAMPSON (Miss K.). **Rust Resistance Trials with Wheat.**—*Bull. of the Welsh Plant Breeding Stat.*, Series C, No. 1, pp. 41-49, 1921.

Experiments were conducted with wheat in 1920 in order to test the resistance of different species and varieties to Black (*P. graminis*) and Yellow Rust (*P. glumarum*) respectively. Tables were compiled showing the relative resistance of the different varieties to both diseases, their cropping power, earliness, and susceptibility to lodging. Generally speaking, the autumn varieties were more susceptible to Black Rust, and the spring (except those sown as early as February) to Yellow Rust. It is thought probable that this difference is more associated with the accident of the time of sowing than with the varieties. Comparatively few varieties are equally resistant to both diseases. Thus Swedish Iron, Dutch Million, and Red Stand Up show a high degree of resistance to Yellow Rust, but are severely attacked by Black Rust. There are, however, certain exceptions, such as Yeoman, which combines great powers of resistance to both Black and Yellow Rust, with early ripening and good cropping. Garton's Early Cone and Percival's Blue Cone are also to be recommended. Burgoyne's Fife and Red Fife are both subject to Yellow Rust, April Bearded somewhat less so. Benefactor, in spite of its high reputation as a cropper, can hardly be recommended on account of its susceptibility to both these rusts.

It is believed, as a result of observations made both with oats and wheat, that there is a connexion between the date of sowing and the severity of the attack. Where the same variety was sown on different dates, the severity of the attack was considerably greater on the later sown one in almost every case.

There would appear to be one or more periods during the maturity of the plant when it is most susceptible to rust. Hence the results obtained have to be interpreted in the light of the conditions under which the tests were made, and might not hold for a different set of conditions.

PUTTERILL (V. A.). **Plant Diseases in the Western Province.**—*Journ. Dept. of Agric. S. Africa*, ii, 6, pp. 525-532, 4 figs., 1921.

Two diseases of recent occurrence due to physiological causes are Chlorosis of Kelsey plums at Wellington, Cape Province, and Lithiasis of Bon Chrétien pear trees at Somerset West, in the same province. An analysis of the soil in which the plums were grown showed that it was deficient in plant food and in humus-forming

organic substances, and low in water-retaining power. The proportion of iron was also low. Lithiasis, which produces wart-like excrescences on the fruit, probably arises from similar causes.

The two chief fungous diseases of the season were black mould, a storage rot of soft fruits caused by *Rhizopus nigricans* Ehr., and *Puccinia chrysanthemi* Roze, which attacks chrysanthemum leaves, forming small brown pustules on the under surface.

PUTTERILL (V. A.). **Plant Diseases in the Western Province**
II.—*Journ. Dept. of Agric. S. Africa*, iii, 3, pp. 259–263,
 4 figs., 1921.

Collar Rot in Orange Trees. The cause of this disease—also named gum disease, gummosis, mal di gomma, foot rot—is not conclusively established. It is particularly prevalent on seedling orange trees in South Africa. The following conditions favour its development: unfavourable soil, improper drainage and irrigation, and deep planting.

The common rough lemon, being very resistant to the rot, is widely employed as a stock on which the varieties of orange are budded. Good results were obtained at Porterville by exposing the main roots of the trees attacked, dusting the diseased areas and roots with lime (building lime) from time to time, and keeping the hole round the tree open. In other parts of the world Bordeaux paste or crude carbolic acid have also been used with success after cutting out the diseased parts. The important part of the process, however, seems to be the thorough aeration and drying out of the crown roots.

MCLEAN (F. J.) & LEE (H. A.). **The Resistance to Citrus Canker of *Citrus nobilis*, and a Suggestion as to the Production of Resistant Varieties in other Citrus Species.**—*Phytopath.*, xi, pp. 109–114, 1921.

The horticultural varieties of the mandarin orange, *Citrus nobilis* var. *deliciosa*, are not seriously attacked by canker in the Philippines. Such infections as are seen are usually clearly associated with punctures or other wounds. Experiments showed that the uninjured leaves are not ordinarily capable of being inoculated, while wounds penetrating the epidermis readily permit artificial inoculation, and the degree of infection in these cases is equal to that found in highly susceptible species such as *C. maxima* or *C. aurantiifolia*. Apparently, then, the epidermis is the structure which renders *C. nobilis* resistant to canker.

The suggestion is made that it may be possible to obtain graft hybrids ('periclinal chimeras'), such as have been obtained in *Solanum* and *Pelargonium*, in which the epidermal characters of the mandarin may be combined with the internal tissue characters of the desirable varieties of *C. maxima*, so that the fruit would retain the qualities of the grape-fruit, while the tree would be resistant to canker.

MCLEAN (F. T.). **A Study of the Structure of the Stomata of two Species of Citrus in relation to Citrus Canker.**—*Bull. Torrey Bot. Club*, xlviii, 4, pp. 101–106, 1 fig., 1921.

From personal investigation, as well as from a review of previous

studies on the subject, the writer concludes that the varying degree of resistance to canker (*Pseudomonas Citri* Hasse) of two different species of citrus is attributable to divergence in the character of the stomatal structure. The species selected for comparison were the Szinkum mandarin, which is resistant, and the Florida grapefruit, which is susceptible. Young leaves, two-thirds of their mature size, obtained from the Philippines, were used for examination.

The stomata of the two species were similar in size, general form, and mechanism of opening and closing. The main differences were found in the cuticular ridge of entrance to the stoma, i. e. the opening in the cuticle leading down to the pore. In the grapefruit the opening is much larger (more than three times) than in the mandarin, and the ridge of entrance has its inner walls more nearly perpendicular to the leaf surface. The actual pore, in the closed stomata, is approximately equal in the two species. The bearing of these differences upon the resistance to citrus canker was then considered.

Canker is caused by a bacterium which is motile in water but entirely passive in air; hence it can only penetrate to the uncutinized cells of the air spaces inside the leaves through continuous films of water. In intact citrus leaves the latter can only form through the stomatal openings. It will naturally require less pressure to drive the water film inward through a wide aperture with nearly parallel walls, such as forms the outer portion of the outer chamber in the Florida grapefruit, than for the same process to take place in the case of the Szinkum mandarin, with its narrow opening and receding walls. Once the bacteria have penetrated to the moist, uncutinized cell-walls, they are able to persist and develop in most varieties of citrus.

These differences account satisfactorily for the varying degree of resistance to canker observed in the two species. It is probable also that other resistant and partially resistant sorts have a similar structural character to the Szinkum mandarin, and a further study of the Rutaceae to establish this point will be desirable.

ELLIOTT (J. A.). **A Mosaic of Sweet and Red Clovers.**—*Phytopath.*, xi, pp. 146-148, 1921.

A communicable mosaic of *Melilotus alba* in Arkansas is briefly described. This can be communicated to red clover (*Trifolium pratense*), horse bean (*Vicia faba*), and spotted burr clover (*Medicago arabica*), but attempts on white clover (*T. repens*) and alfalfa (*Medicago sativa*) failed. It is thought probable that the common mosaic of beans and cowpeas in Arkansas is identical with the disease in question.

SIMMONDS (H. W.). **Report on Coco-nut Districts of Vunilagi and Magnata.**—*Agric. Circular* (Dept. of Agric., Fiji), ii, 3, p. 42, 1921.

On the Vunilagi Estate, trees bearing good heads of nuts and flowers were seen to fall suddenly to the ground, without any apparent reason. Examination of the breaking-point showed the trunk half decayed away. There is first an outer area of dead

wood heavily perforated with beetle borings; inside this there is a stained area generally free from the borings, and next comes the sound wood. The roots were found to be dry and unhealthy. The diseased wood did not generally reach to the base of the tree, but occurred from 6 in. to about 2 ft. 6 in. from the ground. The tree usually attempted to throw out fresh roots at the top of the diseased area, but these roots quickly died. Emergency measures included the cutting out of diseased portions and covering with tar, while the whole affected area was heavily limed and trees adjoining sprayed with lime-sulphur. The disease was reported from several other places on the coast. Its cause has not yet been determined.

SIMMONDS (H. W.). *Notes on Levuana iridescens* Beth Baker.—*Agric. Circular* (Dept. of Agric., Fiji), ii, 2, pp. 19-20, 1921.

Examination of dead larvae and pupae of *Levuana iridescens*, a moth attacking the coco-nut palm in Fiji, showed a fungus which may be parasitic. Parasitism has not yet been proved nor has the fungus been identified.

The Government Bacteriologist, Dr. Carment, whose report is appended, found the mycelium and spores of the fungus ramifying throughout the tissues of the dead larvae and pupae, and cultures made from them produced an abundant growth. The appearances suggested ante-mortem infection. Experiments to test its parasitism are proposed.

STAHEL (G.). *De Sclerotium-Ziekte van de Liberiakoffie in Suriname*. [The Sclerotium Disease of Liberian Coffee in Surinam.]—*Bull. Dept. van den Landbouw*, 42, 29 pp., 11 pl., 1921.

First described in 1913 by Kuyper under the name of 'Coremium' disease, the Sclerotium disease is at present known only in Surinam. The fungus is presumably a parasite of some local member of the Rubiaceae, as the genus *Coffea* is not indigenous in Surinam.

In 1917, and again in 1920, the disease caused much damage, and investigation was called for. The external symptoms consist of brown dead spots on the leaves and berries of Liberian, Excelsa, and Abeocuta coffee. A Canephora coffee-tree next to an Excelsa was also attacked. It was also possible to infect other varieties artificially, e.g. Robusta, Uganda, Mocca, and Surinam, but the fungus only thrives on varieties belonging to the Liberian group.

The spots of the fungus occur almost exclusively on fully grown leaves and ripe berries, and do not develop easily on growing portions of the plant. They clearly exhibit a number of concentric rings, narrow and light-brown, alternating with broad and dark brown. The former are as thick as the leaf, the latter sunken. In Excelsa coffee the spots often cover the whole breadth of the leaf, but they are not so extensive on the Liberian variety, 4 cm. being the maximum width. After a dewy night the under side of the leaf-spots is covered with white bristles, 1.5-4 mm. x 0.05-0.10 mm., which are easily detached and blown away by the wind. These are the chief organs of dissemination of the fungus, and in moist conditions develop on sound leaves, on which they alight, the

characteristic brown spots. Infection results from appressoria-like organs up to 0.5 mm. in diameter which develop from the bristles in contact with the leaf. When the leaves fall to the ground, similar bristles also appear on their upper sides. On the fallen diseased leaves—or in continuously damp weather on leaves still attached to the tree—the mycelium grows centrifugally out of the diseased tissue, and spreads over the surface of the leaf in the form of rhizomorphs which also produce bristles.

The fungus cannot penetrate the berry until it has attained three-quarters of its definitive size. The spots are similar to those on the leaves, and also show concentric rings, the berries being quite covered with the white bristles. The berry forms a particularly favourable habitat for the fungus. The bristles are shorter and thicker (1.2 mm. \times 0.08–0.20 mm.) than on the leaf, and in very damp weather the rhizomorphs spread from the dead berries and kill not only the young berries but also the buds and flower-cushions. They may even spread along the branches and kill the cortex. These rhizomorphs, too, are covered with bristles. The fungus does not, however, penetrate as far as the seed, the endocarp forming an insuperable barrier. The seeds therefore develop normally.

The sclerotia, already discovered by Kuyper, are of an orange or brown colour, somewhat flattened, and not exceeding 0.5 cm. in breadth. In some cases they do not develop on the surface, but within the leaf tissue. On the berry they are generally larger than on the leaf, and in wet weather they appear while the fruit is still on the tree. The attempts both of Kuyper and the writer to propagate fruit-bodies from these sclerotia were unsuccessful; they merely give rhizomorphs in a damp atmosphere.

Microscopic examination showed that the white bristles consist of a bundle of hyphae, 5–8 μ in diameter, and connected with one another by means of numerous anastomoses. In the ripe bristles the hyphae are encrusted with crystals of oxalate of lime. It is to this incrustation and the connexion of the hyphae by anastomoses that the bristles owe their rigidity. Neither Kuyper nor the writer discovered any trace of spore-formation in these bristles, but the former was told by a colleague named Drost that spores had been found some years previously. Kuyper therefore assumed that the fungus belonged to the Stilbaceae, and the bristles were coremia—hence his name for the disease. It is probable, however, that the fructifications in question were those of a *Penicillium*, which frequently occurs on the sclerotia and rhizomorphs. Such sterile bristle-like organs, resembling fruit-bodies, often occur in Clavariaceae, and are included in the genus *Anthina*. The contents of the hyphae of the bristles consist largely of glycogen, which is used up in the formation of appressoria.

The sclerotia are white inside, and covered with an orange or brown cortex, the outer layer of which consists of dead hyphae. This cortex, which is quite homogeneous in sclerotia formed in the open, exhibits in pure cultures dark spots, generally either convex or concave. The hyphae in the plant-tissues and in agar are 3–5 μ in diameter, and 5–8 μ in the rhizomorphs. They contain finely granulated plasma and vacuoles of a considerable size. The

fungus grows intercellularly, and without forming haustoria. The appressoria have a diameter of 0.05–0.5 mm., being smaller on the under side of the leaf than on the upper. On the under side the fungus penetrates through the stomata, and on the upper side it traverses the epidermis. In the latter case the underlying epidermal cells are killed as soon as the cuticle is penetrated. The hyphae then enter the dead cells, and a layer farther in is killed in advance of penetration. The penetration of the stomata and cuticle constitutes the sole parasitic aspect of the *Sclerotium* fungus, which passes the rest of its life in a purely saprophytic manner in the dead tissues of the plant, killed in advance of its growth.

There is scarcely any doubt that the poison emanating from the fungus is oxalic acid, the rhizomorphs and the white bristles being covered with oxalate crystals.

Especially after heavy rain and dew, the spots are encircled by a watery green edge, 0.5–2 mm. in width, which forms the transition to the healthy part of the leaves. This watery zone quickly turns brown and dies. At the edge of the brown spots the leaf-tissue begins to react by the formation of callus, the stomata cease to function, and numerous parenchyma cells are converted into callus cells. In dry weather the fungus cannot develop, so that a few days' absence of rain may give the plant a chance to recover by means of the formation of a thick callus ring. Young plants react more quickly by the formation of callus than older ones, and are therefore better able to withstand the attacks of the fungus.

The fact that the *Sclerotium* fungus requires moisture throughout its development distinguishes it from other parasitic fungi, most of which need a humid atmosphere only at the stage of infection.

The only reference in previous literature to this fungus is the work of Kuyper mentioned above, and as his conclusions with regard to the identity of the fungus cannot be accepted, the name of *Sclerotium coffeicola* n. sp. has been given to it by the author.

The fungus can easily be cultivated on nutrient agar, the bristles, provided they are not too old, readily developing into a mycelium. The centre of the mycelium is often occupied by colonies of bacteria, or the green *Penicillium* or *Aspergillus niger*, which appear in the site of the bristle. Owing to the surplus of oxalic acid, however, the mycelium is not injured by these extraneous growths. Alkaline media are not suitable, but in a weak acid solution a well-developed mycelium, consisting of ramified rhizomorphs, will appear after four to five days, and sclerotia after five to six days, ripening shortly afterwards. Cultures on a mass of finely cut sterilized leaves of Liberian coffee, weighing about 160 grammes, also developed satisfactorily, the fungus completely penetrating the material after twelve days. Numerous appressoria were formed. About the fourteenth day white sclerotia developed which turned brown as they ripened. By the twenty-second day the process was completed. The average weight of a single sclerotium was 0.05 gramme. A quantity of sclerotia crushed in a mortar gave out a smell resembling that of radishes, and this is also noticeable when the fungus develops on the berry.

The bristles may also be obtained in pure cultures on sterilized leaves. Just before the formation of sclerotia, a number of cultures

should be taken from the flasks and exposed to the open air in small clusters. In two days they will be covered with bristles, which remain viable in the laboratory for several months. Sclerotia exposed to the air in a dish die in the course of a few weeks at most, and become covered with the green *Penicillium*, just as in the natural state. Only when the sclerotia remain lying isolated on the ground do they retain their viability for a considerable time. Thus in July 1918 the author strewed under a healthy Excelsa tree 50 grammes of sclerotia. In November 1919 some of these were still there, but three months later none could be found, though secondary sclerotia were numerous on the leaves, and the tree was infected.

Sclerotium coffeicolum is evidently closely related to *S. rolfsii*, which frequently occurs in Surinam on *Canavalia ensiformis*. Both form rhizomorphs and kill their hosts by the production of oxalic acid, and there are also many structural similarities, e.g. the clamp-connexions of the hyphae, which definitely refer the fungus to the family of Basidiomycetes. The sclerotia of the new fungus correspond most closely to those of *Typhula* and other Clavariaceae, which are also characterized by the formation of bristles. *S. coffeicolum*, however, is the only fungus known to the author which is propagated by these means.

The treatment recommended is an immediate application of Bordeaux mixture (2 per cent.), and in severe cases the burning of leaves and berries fallen from the trees, owing to the long duration of viability of the sclerotia described above.

The article is illustrated with eleven excellent plates.

DODGE (E. M.). **Crown-Gall: *Bacterium Tumefaciens* Sm. et Towns.**

—*Journ. Dept. of Agric. S. Africa*, iii, 1, pp. 64–67, 1 fig., 1921.

Crown-gall was first recorded in South Africa by Lounsbury in an article in the *Cape Agricultural Journal* for April 1910, entitled Giant Twig Gall. The disease had then only been observed in the north-eastern districts of the Cape Province. It is now known to occur in all parts of the Union, being specially prevalent in districts liable to hailstorms. It frequently occurs on willows, and is probably widely disseminated by the planting of diseased cuttings.

The disease may manifest itself in two forms, known respectively as crown-gall and hairy-root. It is estimated that in the nursery 90 per cent. of the galls appear on the scion just above the point of union with the root. Young galls are comparatively small, greenish or nearly white, fairly smooth, and soft or spongy in texture. When mature they are usually hard, dark in colour, and from one to several inches in diameter. The disease spreads very rapidly, over 2,000 trees having been infected in 1912 from a single infection on a willow in 1907. Fruit-trees were included in the number of infections.

Hairy-root occurs on apple-trees, and is quite different from the form described above. There is an excessive production of small fibrous roots, growing out at right angles, singly or in tufts, from an older root or stem. There may be a broom-like formation, with extensive branching of the roots at the ends; or the disease

may take the form of a woolly outgrowth originating from a smooth irregular swelling on the larger roots.

The author concludes with an account of the causes and directions for remedial measures, quoted from Hesler and Whetzel's *Manual of Fruit Diseases*.

SERGEANT (E.) & BEGUET (M.). **Sur la nature mycosique d'une nouvelle maladie des Dattiers menaçant les Oasis marocaines.** [The mycotic character of a new disease of Date-palms threatening the Moroccan Oases.]—*Comptes rendus de l'Acad. des Sciences*, clxxii, pp. 1624-1627, 1921.

For the past twenty years date-palms in the oasis of Figuig, Morocco, have been attacked by a disease which threatens to destroy the plantations. Called by the natives 'baïoudh' or 'white', the disease is said to have originated in the south-west, reaching Figuig about 1898. It spreads slowly but continuously, the first case in a plantation being followed by others near by, and then there may be a sudden jump to another plantation. It has not spread farther east than Figuig, and is not known in the Algerian or Tunisian Sahara. The disease is peculiar to the date-palm, other fruit-trees in the vicinity being immune.

The external symptoms consist of a whitening and drying up of the leaflets, together with the appearance of dark reddish-brown veins on the petiole and a gummy degeneration of the fibrovascular bundles. These veins can be followed into the stalk. The leaves are not affected all at the same time, but in irregular sequence. The infection appears to ascend from the roots. Young palms may die in the course of a few weeks, while old ones can survive for three or four years.

Different varieties show varying degrees of susceptibility to the disease, but this is evident only in the length of time taken to kill the tree, the death of which is inevitable. The natives regard the disease as incurable.

Replanting in the same soil is followed by the death of the new palms. Soil conditions do not appear to be concerned, nor have insects been found responsible. Isolations from the reddish-brown lesions gave pure cultures of a fungus in 107 out of 110 cases taken from various localities, while cultures from healthy tissues remained sterile.

The fungus resembles the conidial stages of *Neocosmospora vasinfecta* E. F. Smith. Arrangements are being made to carry out inoculations with it at Algiers.

VAN HALL (C. J. J.). **Ziekten en Plagen der Culturgewassen in Nederlandsch-Indië in 1920.** [Diseases and Pests of Cultivated Plants in the Dutch East Indies in 1920.]—*Med. van het Inst. voor Plantenziekten*, 46, 50 pp., 1921.

The author devotes a separate section to each of the important economic plants, both of European and indigenous culture. Insect pests appear to have been more numerous than fungous diseases in 1920, though the heavy rains of the late summer and autumn gave the latter an opportunity to develop. The west monsoon was

drier than usual, and the east monsoon much wetter. The principal damage caused by fungi may be summarized under the following headings:

POTATOES. *Macrosporium solani* was very prevalent on the east coast of Sumatra. The third month of growth appears to be the most critical time; the disease spreads with great rapidity, and a fortnight after the lower leaves are attacked the whole plant is dead. *Bacillus solanacearum* also did some damage. Leaf-curl, which was very widespread in 1919, was infrequent in 1920.

GROUNDNUT. *Bacillus solanacearum* occurred sporadically, and serious loss was caused by the 'curl' disease, which attacks young plants at the age of about two months. A curl disease occurred also in sweet potatoes, indigo, and *Vigna*.

CACAO. A peculiar disease has been observed which only attacks 'Criollo' trees. The first symptom is a withering of the extremities of the branches, followed in many cases by the death of the tree. The symptoms do not correspond with those of ordinary 'die-back'. The disease is probably due to a fungus.

RUBBER. Considerable damage was done by mouldy rot, due to *Sphaeronema* sp., in Salatiga. Brown bast was common but decreasing in severity, probably on account of improved and less severe tapping methods. Its treatment was chiefly by scraping, followed, when the surface is dry, by the application of paraffin. Stripping has been practically abandoned on the east coast of Sumatra. Stripe canker was prevalent during the wet period, but was less than usual. Where necessary, it is treated by daily applications of 5 per cent. Carbolineum or Izal. Patch canker was only sporadic. Root diseases continued to cause much trouble in young plantations in light soil in Sumatra. Besides the usual preventive methods of uprooting and burning dead wood, treatment by exposing the roots and the application of 20 per cent. Carbolineum or Izal is of the greatest utility. In West Java the commonest cause was *Poria*. At Malang the 'orange root fungus', mentioned in the last report, was prevalent in the same locality and killed a number of the older trees. Die-back was reported in several places. At Malang, under very damp conditions, the young leaves and twigs were rotted by *Phytophthora*; the condition improved when dry weather set in in November. Abnormal leaf-fall in Besoeki was only occasionally due to this fungus; *Gloeosporium* and *Diplodia* caused much die-back in this district. The mildew (*Oidium*) caused defoliation in some places; the disease seems to be worse in certain years than in others. Other diseases reported were *Corticium salmonicolor*, *Ustilina zonata*, *Sphaerostilbe repens*, *Fomes lignosus*, *Fomes lamacensis* (*Hymenochaete*), *Fomes pseudoferreus*, and *Hypochnus*.

* **CINCHONA.** *Corticium salmonicolor* was found extensively, especially on the 'Ledger' variety, after *Helopeltis*. Root disease, stem 'rust', and canker also occurred. In a few cases the 'Mopog' disease (*Moniliopsis aderholdii*) was found in the seed-beds.

COCO-NUT. A case was reported of deaths of young trees with the symptoms of bud rot. *Pestalozzia palmarum* also occurred.

COFFEE. According to some planters the Robusta variety shows increasing susceptibility to *Hemileia vastatrix*. *Corticium salmoni-*

color was very prevalent on account of the wet weather. Root disease was rare.

MAIZE. There have been serious outbreaks of 'yellow disease', due to *Sclerospora javanica*, the damage in some localities being estimated at 30 and 50 per cent. of the crop. An undetermined fungous disease, giving a rusty appearance to the leaves and spikes, considerably affected the yield.

OIL-PALM. A case resembling coco-nut bud rot was reported. The so-called 'Juvenile disease' was again found. The young leaves remain soft or even rot before they are fully opened, so that the crown shows a battered appearance. It does not appear to cause much damage. The cause is unknown.

RICE. Much damage was caused by the root rot ('Mentek') especially in the alluvial soil; even the young seedlings showed signs of the disease, probably because from the very beginning they were under water. *Ustilagoideae vires* and *Helminthosporium oryzae* were also reported.

SUGAR-CANE. Mosaic disease ('Strepenziekte') and red rot were reported, and cases of *Leptosphaeria sacchari* and *Cercospora kopkei* occurred locally; root and sett diseases were prevalent in the young plantings. The most characteristic disease of the season, however, was the 'pineapple' disease (*Thielaviopsis ethacetica*), which occurred during the last months of planting. Owing to delays in transport many diseased setts were imported from the hill gardens and spread the infection.

TOBACCO. Severe damage was caused by the 'lanas' disease (*Phytophthora nicotianae*) in the seedlings, but the attack in general did not develop greatly; while *Bacillus solanacearum*, *Oidium*, and *Sclerotium Rolfsii* did relatively little harm. Red rust, mostly due to an insufficiency of phosphorus in the soil, was prevalent. Mosaic disease occurred principally in the suckers of topped plants.

TEA. Red rust (*Cephaleuros virescens*) frequently succeeded the attacks of *Helopeltis*. Root diseases were also common.

SHAW (F. J. F.). **Studies in Diseases of the Jute Plant.** (1) *Diplodia Corchori* Syd.—*Mem. Dept. Agric. India, Bot. Ser.*, xi, 2, pp. 37-58, 11 pl., 1921.

In 1917 a disease of a pure-line race of selected jute, characterized by the formation of a dense black discoloured band on the stem, was observed on the Pusa Farm. At harvest time 20 per cent. of the early sown crop was infected. A similar disease was found in other parts of North Bihar and in Assam. Later sown crops, which remained small, were, as a rule, free from the disease, as also were the suppressed plants of small size and thin stems that are commonly found in any dense stand as a result of delayed germination and the competition of more robust plants. Where the crop had been thinned for seed production, and the individual plants were larger and more branched, the disease was worse than in the ordinary fibre crop, which is crowded and little branched. Even in the late sown crop, disease appeared in an area where, probably from some local richness of the soil, a forced growth had occurred and the plants were larger than usual. Hence it would appear that only stems of a certain size and maturity are

liable to successful infection. As a rule, the crop grown for fibre is cut before the disease has time to make much headway, and the chief damage is done to the relatively small portion which is grown for seed.

In 1918 and 1919 the disease was less severe in Bihar. It was found, however, to be widely distributed throughout the jute-growing districts of North-Eastern India, and the examination of herbarium material preserved at Pusa showed that it had been collected many years earlier in Bengal, but not recognized as a distinctive disease. Both the cultivated species of jute, *Corchorus capsularis* and *C. olitorius*, and both the red-stemmed and green-stemmed varieties were attacked, but in at least some cases *olitorius* was less liable, and the red-stemmed were less readily infected than the green.

The disease, to which the name 'black band' has been given, is caused by *Diplodia Corchori* Syd., described on jute stems from India in 1910, but not then known to cause disease. The attack takes place on the stem, usually 2 or 3 ft. above the ground level, and often commences at the base of one of the small lateral twigs that normally die back after reaching a length of a few inches. Sometimes it appears to start from a rotting leaf that has fallen over and adhered to the stem. A brown patch forms and gradually extends up, down, and around the stem, ultimately forming a brown ring which soon becomes dense black. The bark splits in longitudinal cracks, exposing the bast fibres. The part above the band withers, loses its leaves, and dries up completely. On the blackened surface of the band innumerable pycnidia appear as small, black, slightly prominent points, which develop below the epidermis and burst out to the surface, on which they discharge great quantities of spores, which remain as a dense coating of black dust on drying. The pycnidia are crowded, 200-300 μ in diameter, and with a prominent ostiole. The mature conidia are dark brown, oval, bicellular, and average $24 \times 12 \mu$ in diameter. The hyphae develop freely in the cortex, phloem, and cambium (especially the latter), and also penetrate the wood.

Inoculations with pure cultures showed that infection occurs through the unwounded stem as well as through wounds. In the former case it was not settled whether penetration through the unbroken cuticle could occur, as the only point through which entry was obvious was in the neighbourhood of a lenticel. Mature plants were killed in some cases in six to fourteen days after inoculation. The bark is extensively destroyed down to, and including, the cambium. The fungus produces a cellulose-dissolving enzyme, and can penetrate a cellulose diffusion cell and rot pure cellulose. Marked differences were found to occur in the results of the inoculation, experiments carried out during three seasons. Some of these were connected with the variety and size of the host plant, and others appeared to depend on climatic factors at the time of and during the period following inoculation. A relatively high humidity is favourable to the disease and explains the severity of the attack in 1917. In conditions of lower humidity and higher temperature many inoculations failed.

As the disease was prevalent on the crop of selected pure-line

jute intended for distribution, and as the seed from this was contaminated by spores, the whole of the seed (amounting to many tons) was treated by steeping for ten minutes in 2 per cent. solution of copper sulphate. The treatment was found to inhibit the germination of the *Diplodia* spores without in any way injuring the seed.

Further experiments in 1918 and 1919 showed that seed-borne infection is not common, little difference being found in the number of cases in plots sown with treated and with untreated seed. Experiments to test the possibility of the parasite remaining over from one season to the next in the soil gave inconclusive results, but the number of cases did not appear to be greater in plots which had been under jute for several seasons than in those not previously sown to jute.

COCKAYNE (A. H.). **Fireblight and its Control—The Hawthorn Question.**—*New Zealand Journ. of Agric.*, xxiii, 1, pp. 30–36, 1921.

Fireblight, caused by *Bacillus amylovorus* (Burr.) Trev., was first found in New Zealand in the latter part of 1919 and had certainly only been introduced shortly before. During the summer of 1919–20 a very careful survey was made of all New Zealand orchards, and the then distribution of the disease was ascertained to be scattered throughout the North Auckland and Auckland Land Districts, its southernmost and northern points being some 180 miles apart. The largest area generally affected in 1920 was the Waikato district, where it was very common on hawthorn (*Crataegus*) and pear and apple trees. The widely separated points of infection indicate that the disease had been distributed by means of diseased nursery stock, but definite information regarding this point has not been satisfactorily secured. During the 1920–21 season the disease has spread considerably.

At the time when the first outbreak was discovered it was found that the ordinary hawthorn, which is largely used in Auckland Province for hedges, became badly infected, and laboratory work carried out in the winter of 1920 showed that in New Zealand the disease winters over in the hawthorn. It has also been shown that the districts where hawthorn is abundant became more rapidly and more generally infected than where that plant is not prevalent, and the present position is that wherever hawthorn is present in an infected area no control of the disease in orchards can be satisfactorily carried out until the hawthorn is completely eliminated. This position is confirmed by the fact that during 1920 a great amount of work was done in infected districts in the cutting out of infected branches of fruit-trees, and also in the removal and burning of badly infected trees. In all areas, however, where hawthorn was abundant and infected, the value of such work was nil, owing to rapid reinfection of the orchards from diseased hawthorn in their vicinity. On the other hand, in districts where the hawthorn factor was absent, the disease seems to have been stamped out.

Fireblight affects only certain members of the rose family, and may be said to be confined to the genera *Pyrus* and *Crataegus* in New Zealand. In addition, another genus, *Amelanchier* (june-

berry), is regularly infected in America. Very occasionally in America the genus *Prunus* is also infected, and there are records of apricot, cherry, and plum having been attacked, but this is quite unusual. In New Zealand the author has identified fireblight in his laboratory on apple, pear (which has suffered most), quince, hawthorn, and medlar. Cross-inoculations have been successful. So far in New Zealand it has not been found on mountain ash, nor on any but the ordinary species of hawthorn, nor on japonica (*Pyrus japonica*), but all these plants are likely to carry it.

The disease is carried through the winter in the tissues of host plants, mainly towards the edge of the wounds that were produced the previous season ('hold-over cankers'). In the spring the bacilli in these lesions multiply enormously, and drops of exudate containing myriads of the organism exude on the surface, and are carried by insects on to the flowers and blossom-infection takes place. It has been shown that the bacillus taken from dried ooze on the bark and kept dry in the laboratory remains alive for nine months. It has also been shown that a common Australian sucking insect, *Sephena cinerea*, is a very active carrier in the autumn. Once flowers are infected honey-bees may spread the disease to every flower in an orchard within a few days. After flower-infection has ceased, shoot-infection sets in, and may continue throughout the summer and autumn. Shoot-infection frequently rapidly spreads to the larger limbs, and entire branches may be quickly killed and the formation of large lesions occur, such lesions carrying over the disease for another season. In certain instances the bacilli were found in the tissues of the wood adjacent to the cambium at a distance of over 15 in. below any visibly diseased tissue. This fact well explains the failure that has often resulted in the cutting-back of twigs and branches, and emphasizes the urgent necessity of sterilizing the pruning-knife after every cut. Where the trees dealt with are young, vigorous growing ones, in which disease is spreading rapidly, the fact that the cut appears to have been made through apparently sound wood is no criterion that all the diseased wood has been removed.

As regards control measures, the position does not seem at all hopeful in the author's opinion. Spraying experiments have been found to be useless. The method of injections of different materials into the tree itself has been suggested by Dr. R. J. Tillyard, of the Cawthron Institute, who is carrying out certain work along this line, as is also the New Zealand Department of Agriculture, but the author is very doubtful of the efficacy of this treatment. In order to eliminate the 'hold-over cankers'—the first essential in control—the hawthorn will have to be destroyed in every important fruit-growing district in New Zealand, a task of very great magnitude.

RIVERA (V.). *Osservazioni sopra la moria dei mandorli prodotta dal Fomes fulvus*. [Notes on the disease of Almonds caused by *Fomes fulvus*.]—*Boll. mensile della R. Staz. di Patologia vegetale*, ii, 1-4, pp. 28-29, 1921.

In the Northern Abruzzi the destruction of almond-trees by *Fomes fulvus* is frequent. The disease not only affects the trees

already flowering, but apparently infects the surrounding soil, since young plants substituted for those killed by the fungus are suddenly attacked in full development. During the early stages the trees appear quite normal; later the branches wither. Fruit-bodies appear on the cortex only when decay has actually set in.

At the beginning of the disease the wood looks partially blackened; then the cells of the parenchyma, the vessels, fibres, and tissues of the medullary rays seem to be replaced by a yellowish-white substance; in more severe cases the weight of the timber is reduced, and it is rendered useless either for industrial purposes or for fire-wood.

The death of the young plants does not appear to be directly due to the action of the fungus, no mycelium being observed in the tissues. Most probably it is accounted for by the contact of the roots with substances secreted from the roots of trees previously attacked, or from the fungus which invaded them.

At first sight it might be supposed that contagion was transmitted from one tree to another by the roots, since when one is diseased the whole row dies. An examination of the roots, however, leads rather to the belief that the damage is done by the pruning-shears, which inoculate the tissues of the healthy trees with fragments of mycelium and diseased wood from the trees on which they have just operated. The sterilization of the shears with boiling water or phenol is recommended.

LOSCH (H.). **Eine Beobachtung über Apfelmehltaubefall und seine Beziehung zur örtlichen Lage.** [A Note on Apple-Mildew and its Relation to the Locality.]—*Zeitschr. für Pflanzenker.*, xxxi, 1-2, pp. 22-24, 1921.

In September 1919 the writer visited an orchard in Württemberg, situated on the south-eastern slope of a ravine. The upper part of this orchard was severely attacked by apple-mildew, which gradually decreased on the lower parts of the slope and was quite insignificant at the bottom. The soil consisted of a light variegated marl, which retained the heat. The rays of the sun struck full on the upper part of the orchard, but lower down they reached later in the day and naturally fell at a less acute angle, while the bottom was shaded by the high trees of an adjoining orchard during the forenoon. Thus the situation may be described as extremely hot and dry in the upper part, gradually descending to a cooler and moister atmosphere.

The decline of the apple-mildew ran strikingly parallel to that of the hot and dry section of the orchard. According to Rebholz, apples with light-green leaves covered with grey down, e.g. Landsberger Reinette, Bismarck, &c., are especially liable to mildew in hot situations. The case in point illustrates either a direct connexion between mildew and the situation, or an indirect relation, since the variety with which the orchard was planted (Beauty of Boskoop) requires moisture, and is therefore more susceptible in the heat. Oak-mildew presents similar features. It remains to be seen whether the foregoing observations apply to apple-mildew in general, or only to certain varieties.

PEYRONEL (B.). **Il marciume amaro o marciume del cuore delle mele e delle pere.** [Bitter or Core Rot of Apples and Pears].—*Boll. mensile della R. Staz. di Patologia vegetale*, ii, 1-4, pp. 23-27, 3 figs., 1921.

Except in extreme cases the external appearance of the fruit is quite normal. A longitudinal section, however, reveals a zone of discoloured, soft, and bitter pulp round the ovary. In the early stages the interior of the cells and the surface of the seeds are covered with a cobweb-like growth, which is succeeded by a pulverulent efflorescence of a pale rose colour. Even the fibrous tissue bordering the tube connecting the ovary with the calyx is affected and the rot gradually spreads to the surrounding pulp, rendering it quite unfit for food. The entire fruit finally mummifies.

The mycelium consists of hyaline hyphae, cylindrical, ramified, septate, and containing an abundant plasma of oleose drops. These hyphae form the web in the ovary, the rose-coloured efflorescence of a later stage being produced by the conidial fructifications. The latter consist of erect conidiophores, sub-cylindrical, septate, hyaline, and terminating in a tuft of bicellular, obovate, pale pink conidia.

The fungus is a common mould, *Trichothecium roseum* Link (= *Cephalothecium roseum* Corda), ordinarily found as a saprophyte on dead vegetable matter. It is already known in America as the agent of pink rot in apples previously attacked by *Fusicladium dendriticum*. The mycelium of *T. roseum* is unable to penetrate the peel of sound fruit, and it is evident that the fungus enters the pear by way of the calyx. In the case of the apple it would be more accurate to describe the place of entry as the peduncular sinus, from which the fungus arrives at the ovaries by way of the fibrovascular bundles.

Probably the germination of the conidia and the entry of the mycelium are facilitated by the practice of placing fruits of the best varieties—which are the most subject to attack—on a level space with the calycine sinus inverted. This promotes humidity and allows any casual spores to germinate. The fruit should be kept in a dry place, and arranged in rows, not heaps.

HURD (ANNIE MAY). **Seed Coat Injury and Viability of Seeds of Wheat and Barley as Factors in Susceptibility to Molds and Fungicides.**—*Journ. Agric. Res.*, xxi, pp. 99-122, pl. 13-24, 1921.

A study of some of the factors, especially the physical condition of the seed-coat, which enable saprophytic fungi such as *Penicillium* sp. and *Rhizopus nigricans* to attack the seed, and of the relation of mechanical injuries sustained by the seed-coat to seed-treatment injury. These two fungi were used as they were the two causing most trouble in blotter germination in the laboratory. They were not usually found on healthy unbroken seeds, but if the seed-coats were broken over the endosperm, they were found invariably to be badly attacked under non-sterile conditions of blotter germination. An unbroken seed-coat was also found to protect against these fungi in damp storage and in the soil. But infection of uninjured seed was obtained by retarding germination by means of low

temperatures, as, for instance, by keeping them for seven days at 10° C. and then removing them to a higher temperature. Even when there is no mechanical break, death or injury of the seed-coats from other causes, such as drying the seed after formalin treatment, renders the seed susceptible to attack. When the seeds are kept after treatment at a degree of humidity which prevents the formation of paraformaldehyde by evaporation of the formalin this injury ceases. Seed stored damp after treatment by 1 to 320 formaldehyde solution was uninjured, but if allowed to dry it suffered serious injury, especially from *Rhizopus*, under certain conditions. Washing with water after treatment removes the danger thus resulting from subsequent drying. Perfect seeds, killed by boiling or by prolonged exposure to a saturated solution of copper sulphate, were also attacked, except that *Rhizopus* did not attack those killed by the copper sulphate, *Penicillium* being the active agent in this case. Inoculated seeds germinated in the soil showed, when *Penicillium* was used, a normal germination with uninjured seed-coats and when the injury was confined to the region over the embryo, while when the coats were broken over the endosperm germination was reduced and those seeds that germinated gave weak seedlings with stunted roots and arrested growth. Seed kept throughout at 10° C. escaped this injury. In stored wheat injury from moulds depends on the same factors, but humidity is of great importance. *Penicillium* will only develop on wheat stored at a humidity of at least 80 per cent., *Aspergillus* requiring 70 per cent. These moulds develop more slowly on seed treated with copper sulphate or formaldehyde, *Penicillium* being especially sensitive to the latter. But the seed must not be allowed to dry after formaldehyde treatment or else the latter must be removed by washing.

The author holds that all seed injury from the recommended copper-sulphate treatment for smuts is due to broken seed-coats. The unbroken seed-coats are impenetrable (except after prolonged exposures) by salts. Hence machine-threshed seed is more injured, an examination showing that from 30 to 100 per cent. of such seed have the seed-coats broken. If the injury is over the embryo, even a five-minute dip in a 1 lb. to 40 gallons solution of copper sulphate causes damage, but if over the endosperm only, a longer exposure is required, damage being slight after an hour, or else a stronger solution, damage being extreme with a saturated solution after an hour. Seeds apparently unbroken are usually uninjured after six hours in a saturated solution. Liming does not prevent extreme injury when the seed-coats are badly broken, the copper sulphate entering too rapidly to be neutralized. In slight injury, dipping the seeds in lime is effective in neutralizing the copper sulphate before it has time to penetrate.

No matter how extreme the seed-coat injury is, a ten-minutes' dip in 1 to 320 formaldehyde solution (1 pint formaldehyde in 40 gallons water), followed by a ten-minutes' drain, causes no injury to the embryo, and even twice this strength is harmless, provided paraformaldehyde injury is avoided. 1 to 80 solution, however, causes extreme injury when the seed-coats are broken over the embryo, but this strength is never recommended. It is only when

paraformaldehyde is allowed to form during the drying of the seed that the ordinary strengths used can cause injury. If the seed is not dried, but is sown moist in damp soil or kept in damp storage, paraformaldehyde does not form and there is no injury. A perfect seed-coat delays paraformaldehyde injury but does not prevent it.

The greater susceptibility of barley to seed fungicides, especially copper sulphate, than wheat appears to be due to the fact that the barley kernel, in certain varieties at least, unlike wheat, has a ragged hole where it has been broken from the rachis, and the coats are weakened or injured at this point. When treated without separating from the rachis little or no injury resulted. Varieties differ in this respect, and the results do not always tally, so that further work in this direction is required.

GRUBB (N. H.). **Tests of Fungicides on Apple Trees.**—*Journ. of Pomology*, ii, 2, pp. 93-114, 1 fig., 1921.

Experiments carried out at the East Malling Research Station to test the comparative values of different fungicides applied to apple trees showed that Bordeaux mixture (8-8-100) was more effective against scab (*Venturia inaequalis*) than lime-sulphur. A certain reduction in the value of the fruit is caused by 'Bordeaux injury' or 'russetting', but this is counterbalanced by the heavier crop of the sprayed trees. Ammonium polysulphide was slightly less effective than lime-sulphur as a scab fungicide, but greatly increased the yield. As regards 'spreaders', Saponin and Saponex failed to improve ordinary lime-sulphur in the case of scab, but increased its effectiveness against mildew (*Podosphaera leucotricha*). Lead arsenate proved of considerable value when added to lime-sulphur in the treatment of scab, but appeared to reduce its effects against mildew. The best fungicide against mildew of all those tested was ammonium polysulphide with soap, while Bordeaux was the least useful. The series of experiments on canker is not yet complete, besides which only two varieties, Worcester and Grieve, were sufficiently affected to necessitate a trial; but it is certain that spraying reduces to less than one-fifth the new bud infections caused by the presence of an old spore-producing infection. Summer spraying is likely to improve the keeping quality of the fruit by reducing the attacks of brown rot (*Sclerotinia fructigena*).

SCHAFFNIT (E.). **Eiweisserdalkaliverbindungen als Zusatzstoffe für Bekämpfungsmittel zur Erhöhung des Haftvermögens.** [Compounds of Albumen and Alkaline Earths for admixture in Fungicides and Insecticides, with a view to increasing the adhesion of the latter.]—*Zeitschr. für Pflanzenkr.*, xxxi, 1-2, pp. 19-22, 1921.

The author is of opinion that the substances used hitherto for increasing the adhesion of spraying mixtures, such as resin-oil soap, molasses, &c., being soluble in water and consequently washed away by rain, are unsuitable. Soap solutions are known, besides, to impair the functions of the leaves and to delay or even prevent the development of flowers and fruits.

An ideal adhesive substance for spray fluids should satisfy the

following desiderata: (1) the spray fluid should be fixed by the adhesive substance on the leaves so firmly as not to be washed away by rainfall, (2) the adhesive substance should possess the property of becoming insoluble after it has been sprayed on the surface of the leaves, (3) it should not interfere with the assimilatory functions and the development of the plants treated.

The property mentioned under (2) is to be looked for among colloidal substances, and more especially in the group of albumens, globulins, proteins, &c., when they are in certain chemical combinations. Trials made by Perraud with dried blood and albumen powder (probably dried white of egg) have shown that these substances remain soluble after drying on the leaves and are washed away by rain; they are therefore not used in general practice. On the other hand, certain albuminous substances have the property of forming with alkaline earths, such as lime for instance, compounds which are at first soluble in water, but which, after desiccation, become insoluble; compounds with barium salts are even less soluble than those with lime.

Trials were made in this direction with compounds of albuminous substances and alkaline earths, and it was found that casein and lime compounds were excellent as adhesive admixtures and satisfied all the above-mentioned requirements.

The casein is obtained either through natural souring or by artificial coagulation with hydrochloric acid, acetic acid, or rennet; the milk albumen is then washed in water, freed of fats, and dried. On being mixed with an alkaline earth and diluted with water it gives a slimy mass which is then added to the spraying liquid. The author gives the following formula as an example: 20 gm. of casein reduced to a dust-like powder is mixed in a mortar with about 5 gm. of strongly burnt quicklime; 150-200 c.c. of water are then slowly added, and the whole is allowed to stand for half an hour, when a thick slimy mass is obtained. This mass is diluted with more water to a liquid state and is then poured into 100 lit. of Schweinfurter green or Bordeaux mixture, and the whole is well stirred. The addition of this adhesive substance secures also a much finer distribution of Bordeaux and other mixtures over the leaves.

A series of experiments was undertaken to determine the quantities of copper and arsenic still adhering to the leaves of treated plants after the lapse of a certain time. They showed that the use of the adhesive substance added to liquid sprays in some cases more than doubled this quantity, while in a case where the adhesive substance was added in a powdered state to colloidal copper preparations, the quantity of the control found on the leaves, treated while wet with dew, was even trebled.

The present high prices of casein exclude the possibility of using it on a large scale in practice, and the author is now looking for a substance possessing the same properties as casein, but more economically practicable. If he succeeds, he believes that the cost of treatment can be reduced by using weaker preparations and by doing away with the necessity of frequently repeated treatments. Besides, by adding the adhesive substance in a powdered state to dusts, it will be possible to investigate more closely the value of the latter as compared with liquid spraying; the development of dusting has

been checked so far by the fact that the fungicide is too easily washed off by rain to act efficiently.

THURSTON (H. W., Jr.). **A Note on the Corrosive Sublimates Treatment for the Control of *Rhizoctonia*.**—*Phytopath.*, xi, pp. 150–151, 1921.

A table is presented giving the percentage of sclerotia viable after various treatments with HgCl_2 . A solution 1:1,000 was found to kill all sclerotia in five minutes, and a 1:2,500 solution killed all in two hours. Greater dilutions or shorter treatments than those mentioned usually allowed some growth of the sclerotia.

VOGT (E.). **Ein neuer Schwefelapparat.** [A new apparatus for applying sulphur.]—*Nachrichtenblatt für den deutschen Pflanzenschutzdienst*, 1–4, p. 29, 1921.

At present there are two methods of sulphur treatment. In the older widely spread method sublimed sulphur ('flowers of sulphur') is dusted on with bellows, while the more recent method is based on the use of the so-called colloidal sulphur ('Gel-sulphur'), the extremely fine particles of which remain in suspension in water long enough to allow of it being sprayed in a liquid mixture. Both methods are devised to cover the plants treated with the thinnest possible uniform coating of sulphur so as to obtain the best results with a minimum quantity of sulphur. From this point of view, the liquid spraying is unquestionably superior to the dusting, and will wholly supplant the latter if a method can be found of treating the plants both with sulphur and copper preparations in one and the same spraying.

Trials have recently been started with a third method of using sulphur, which deserves some attention owing to the great advantages it presents. It was demonstrated by its inventor, Dr. Rupprecht, in August 1921 in Munich and Dahlem, in the presence of the representatives of the Department for the Protection of Plants.

The very handy and light apparatus works, according to the inventor, as follows: 300 gm. of pure roll sulphur (stick sulphur) contained in a small iron pan is liquefied and brought to the boiling point (448°C.) on a spirit lamp, which heats at the same time a circular copper boiler containing 400 gm. of water; the strongly superheated steam of the latter is forced under high pressure through the boiling sulphur and vaporizes it into small mist-like drops. In consequence of the sudden cooling in the open air, the little drops of sulphur do not harden immediately, but preserve for several hours their liquid form (plastic sulphur); they possess in this state a high degree of adhesion, not otherwise common to sulphur. The use of the apparatus is simple and does not present any danger. No injurious gases are formed during the process, though it is possible to obtain any quantity of sulphur dioxide by lighting the stream of sulphur vapour. Seeing that the drops of the sulphur cloud are only a few thousandths of a millimeter in diameter, the quantity of sulphur used is exceedingly small. A few grammes of sulphur are quite enough to fill an average greenhouse with clouds of sulphur, which in a very short time cover all

free surfaces, such as leaves, tables, window-panes, &c., with a very thin film-like coating of sulphur, which is so adhesive that a strong stream of water from a hose cannot remove it from the glass panes.

But along with its great advantages this method, as described above, has faults which must limit its use in vineyards and orchards. While the apparatus gives excellent results in closed spaces such as greenhouses, it can be successfully used in the open air in calm weather only. A weak current of air is sufficient to blow away the sulphur cloud and render its action at least very doubtful. The makers of the apparatus claim to have constructed meanwhile a new model which works better.

A practical introduction of the method would undoubtedly bring about a complete transformation of sulphur treatments as used in vineyards. While it is now necessary to treat each plant individually with the dusting machine or sprayer, it would be quite enough to place a few of the new machines in a vineyard, or to carry one slowly from spot to spot, in order to envelop the whole vineyard in a cloud of sulphur on a windless day. It would not cause a larger consumption of sulphur owing to its fine pulverization. Further trials on a large scale are needed to show whether this new method can be used in practice and what results are obtained.

STEVENS (F. L.). **The Relation of Plant Pathology to Human Welfare.**—*American Journ. of Botany*, viii, 6, pp. 315-322, 1921.

The losses due to plant diseases in the United States alone, for the year 1919, are given as follows in the Plant Disease Survey Reports:

For the five leading cereals	482,695,000 bushels.
For Potatoes	86,997,000 bushels.
For Tomatoes	307,168,000 bushels.
For Sweet Potatoes	58,841,000 bushels (more than half the crop).

Crops of world-wide interest are sometimes destroyed; e.g. the Coffee rust destroyed 272,000 acres in Ceylon in a short time. 20,000 acres of bananas planted in Panama had to be abandoned as a result of Banana wilt, thus rendering useless large railway connexions. The Chestnut bark disease caused a loss of \$25,000,000 from 1904 to 1911, and will cause much more as it invades the Appalachians. Land values may be seriously depreciated, as when a farm in the Tobacco Belt becomes infected with Tobacco wilt. Even after harvest the destruction continues during transportation and storage; an annual loss of thirty million dollars is said to occur in the United States between the field and the consumer.

That diseases are more common now than formerly is due to the increased facility of transportation between countries and the greater congestion of crops within countries.

Plant pathology, which originated barely half a century ago, now absorbs large federal and state grants, and the question arises what return it makes. Its achievements fall under several general headings: protective applications; sprays and dusts; excision; seed steeping; general sanitation, leading to diminution of infective

material; breeding for disease resistance; modification of agricultural practice; and quarantine restrictions.

With the exception of breeding, the great advances have all been made by strictly scientific investigation, and not by empirical methods, and the recent discoveries in Mendelism are of most value when the low acreage value of the crop precludes expensive methods.

To quote a few illustrations of utility: cereal steeps (costing three cents an acre) eliminate certain smuts; if universally practised, one state could save 7,000,000 bushels of oats. One spraying of Peach curl may be worth \$400 an acre. By early extermination, Coffee rust, found in 1902, was eliminated from Porto Rico, and the coffee plantations of America saved from it. Rice smut was similarly cleared out of South Carolina in 1898. Florida expended \$1,500,000, and has completely exterminated Citrus canker, after it was well started; the annual value of the crop is \$50,000,000.

Greater benefits will be derived as the science advances. Many great problems still exist that will only yield to patient, scholarly attack. By their intricacy they demand more concentration, better equipment, and longer periods of research than of old, in a word, greater specialization, often necessarily accompanied by co-operation of workers in different branches. A division of labour is also developing, and rightly, between the many aspects of plant disease investigation and control: research, extension (propaganda), testing of fungicides, surveys of disease, seed certification, quarantine control, and the like.

Pathology should come into closer co-operation with the other branches of botany and, indeed, with the other sciences. Botany is less of a power than she should be because, unlike chemistry, she has not maintained her unity: each useful offspring has gone far from the maternal influence. Integration of the various phases of botany rather than further disintegration is to be desired. The ranks of fundamental botany are in danger of depletion with the numerous temptations in the applied field. The individual worker, such as is most likely to be found in academic surroundings, willing to devote a lifetime to the development of his field, requires to be encouraged. The workers in Government institutions are under certain obvious disadvantages. Sir A. D. Hall is quoted as saying that 'a government is unfitted by its very nature to conduct fundamental research', and the author emphasizes the danger of the pressure for immediate results and the limitations of the 'project system' under existing conditions. The foundations of pathology require to be added to, and its structure buttressed by the isolated worker fired with enthusiasm.

SALMON (E. S.) & WORMALD (H.). Varietal Resistance to American Gooseberry Mildew in Red Currants.—*Gardeners' Chron.*, lxx, p. 47, 1 fig., 1921.

Certain varieties of red currants in the fruit plantations of Wye College, Kent, were found to be attacked by this mildew after a very virulent epidemic on gooseberries. On June 26 the mildew was observed on young shoots of red currants, interplanted with Allington Pippin apples. The leaves were somewhat curled, show-

ing large white powdery patches on the under surface. Further examination revealed the brown scurfy patches of the perithecial stage on the leaves, the young stem, and the green berries.

The border in which the attack occurred was mainly planted with Fay's Prolific, but the affected bushes did not belong to this variety, being 'rogues' of various types—probably Raby Castle was among them. In another part of the plantation a block of Raby Castle bushes adjoining Fay's Prolific was attacked, while the latter remained immune. These instances afford sufficient evidence of the resistance of Fay's Prolific to the disease in question.

The economic importance of the occurrence of Gooseberry Mildew on red currants lies in the hibernation of the ascospores on the leaves, whereas in the gooseberry it is usually confined to the stem. Early outbreaks of mildew on gooseberry bushes may therefore be due to the presence in the soil of spores carried there on red currant leaves. Affected shoots of red currant should be burnt before the leaves fall.

BROOKS (F. T.). The Inheritance of Disease-Resistance in Plants.

—*Trans. Brit. Mycol. Soc.*, vii, pp. 71-78, 1921.

The writer gives a summary of the knowledge of the inheritance of disease-resistance in plants, quoting data from Biffen and from unpublished work by Armstrong, which indicate that resistance of wheat to *Puccinia glumarum* is a Mendelian recessive character. Resistance of wheat to *Erysiphe graminis*, on the other hand, is found by Armstrong to be a dominant character.

GAGET (J.). La Dégénérescence de la Pomme de Terre.—*Journal d'Agric. Pratique*, N.S., xxxv, 16, pp. 316-318, 1921.

The author attributes Mosaic and Leaf-curl principally to the punctures of insects. Bacteria may also gain admission to the plant in wounds caused by insect punctures.

FOËX (E.). Dégénérescence de la Pomme de Terre.—*Comptes Rendus de l'Acad. d'Agriculture de France*, vii, 18, pp. 432-434, 1921.

Tubers of potatoes submitted for examination by M. Gaget appear to be infected with a disease quite distinct from Mosaic or Leaf-curl. They show traces of the presence of insects, and it is probable that the unhealthy appearance of the eyes, which are black or brown in colour, is due to their innumerable punctures. The tubers which give rise to plants attacked by Mosaic or Leaf-curl are comparatively healthy in appearance, so much so that it is almost impossible to distinguish them in the early stages. Sections of the eyes of the tubers submitted for investigation reveal the existence of separate cellules, usually situated in the epidermic and cortical parenchyma, but sometimes also in the central cylinder. The bast is not more frequently attacked than the other tissues.

It will be evident that this disease does not correspond with Leptonecrosis, which, according to Quanjér, always accompanies Leaf-curl, and the investigation of its origin should be continued.

